ALARA Experience With Moving an Intense ^{252}Cf Neutron Source*

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Topics

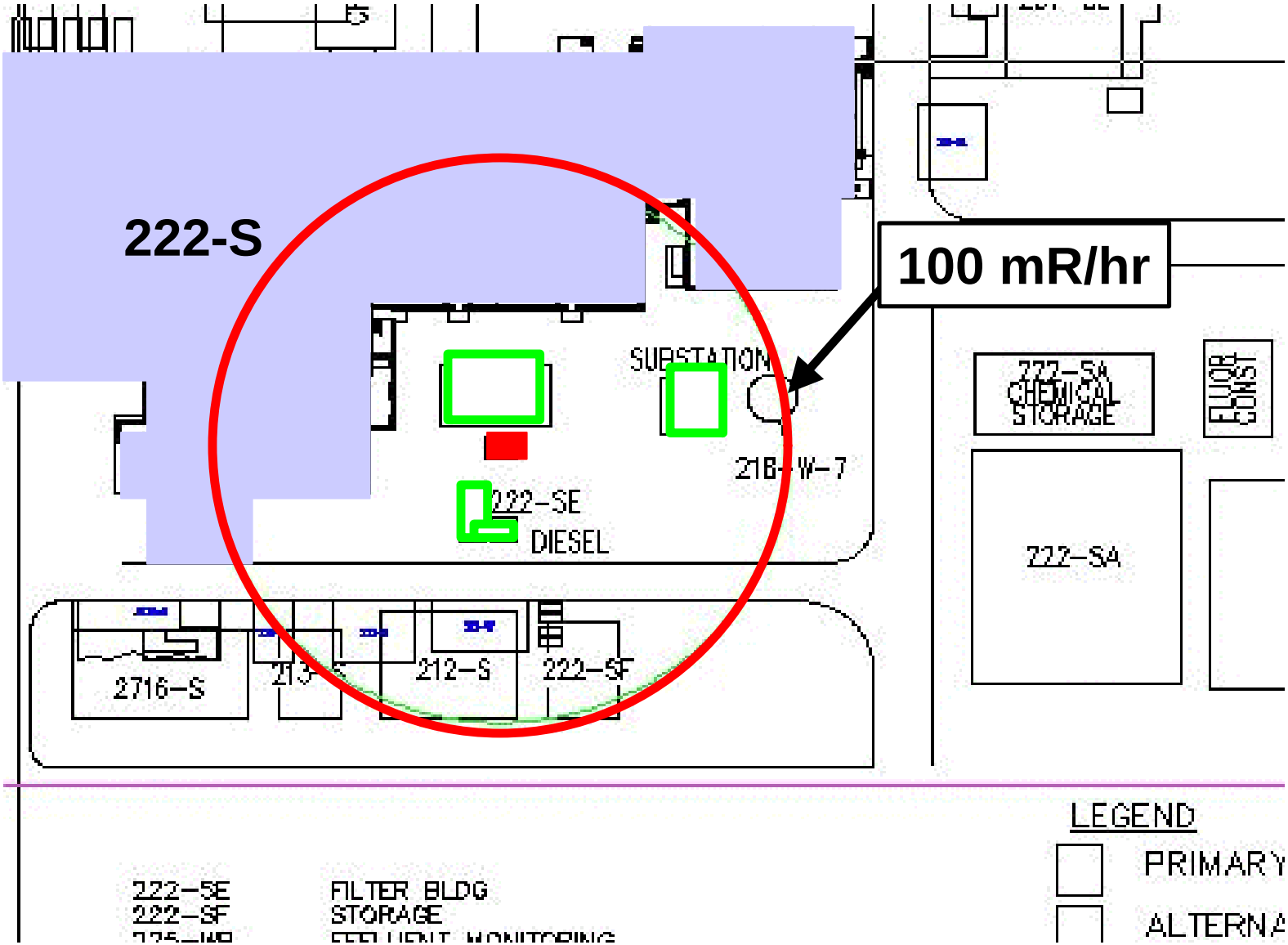
- Purpose
- Preparation
  - Historical Review
  - Limitations
  - Team Definition
- Mockups
  - Cold
  - Hot
- Evolutions
- Conclusions

Purpose of Transfer

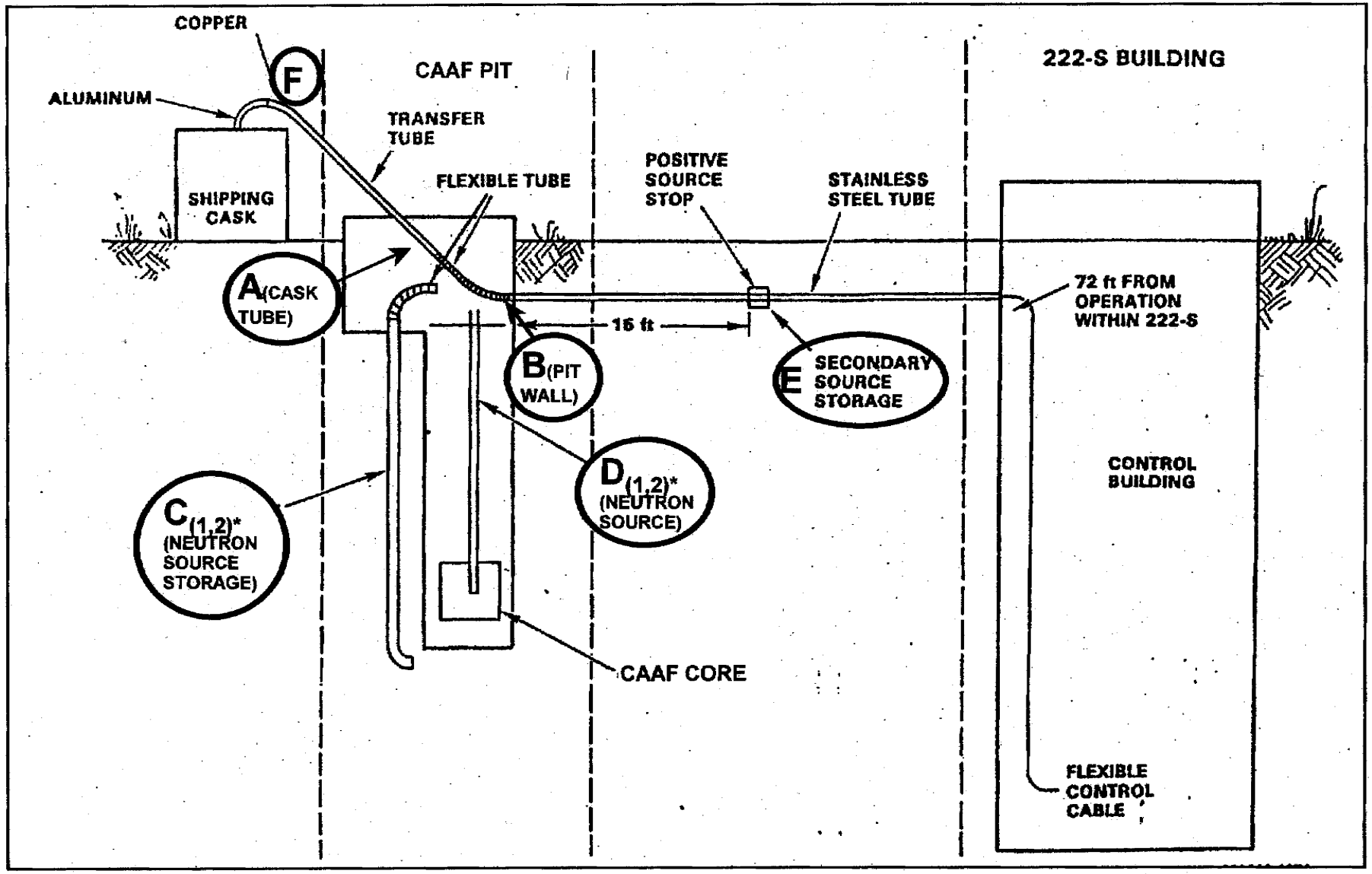
- New Mission for Laboratory
  - Hanford tank waste analysis
  - Neutron activation analysis for sodium
- Existing Sources Over 10 Years Old
  - ^{252}Cf half-life 2.64 y
  - Below useful analytical neutron flux
- System Uses 2 Sources ~50 mg Each
- Supplied By ORNL

Source Capsule

Transfer Location



^{252}Cf Source Transfer System



Historical Review

- Original Source Installation 1989
- 2 Personnel Doses Known
  - 10 and 120 mRem neutron
  - Other workers (~5) unidentifiable (retired)
- Available References
  - Video of operations
  - Original procedure
  - Engineering drawings

1987 Video Reference

Limitations

- System Design ~1976; Used Once, 1989
- Nearly ‘Free Air’ Source Transfer
- New Construction Restricted Cask Location
- Intense Source Field ~10 Gy@ 0.3m
- Non-view Remote Operation
- Old Source Return Required
- Coordinate With ORNL Source Fabrication

Team Definition

- Chief Surgeon and Team Approach
- Solicited Required Talent Early
  - Engineering
    - As built updates, design changes
  - Crafts – testing and operations
    - Millwrights, pipefitters, riggers, crane operators
  - Laboratory technicians
  - Health physics technicians
  - Safety - oversight
  - Transportation/shipping
  - Technical staff – nuclear science

Basic Approach

- Double Team To Avoid Personnel Absence
- Complete Cold Mockup Except Cask
  - Simulated cask
  - No crane operations
- Hot Mockup With Old Sources
  - New procedure test
  - Evaluate controls
  - Train 2 teams
- Actual New Source Transfers

Planning Tools

- Radiological Screening (3)
- Automated Job Hazard Analysis (3)
- ALARA Management Worksheet
- Walk-downs/Mock-ups
- Frequent Team Meetings
- Project Planning Program – Scheduling
- Job Review Committee (2)
- Pre-Job Briefings
- Post ALARA Review

Support Functions

- Procurement
- Planner/Scheduler
- Safety Review
- Special Nuclear Materials Control
- Drafting/Engineering
- Job Control
- Operations/Person-in-charge
- Procedure Development

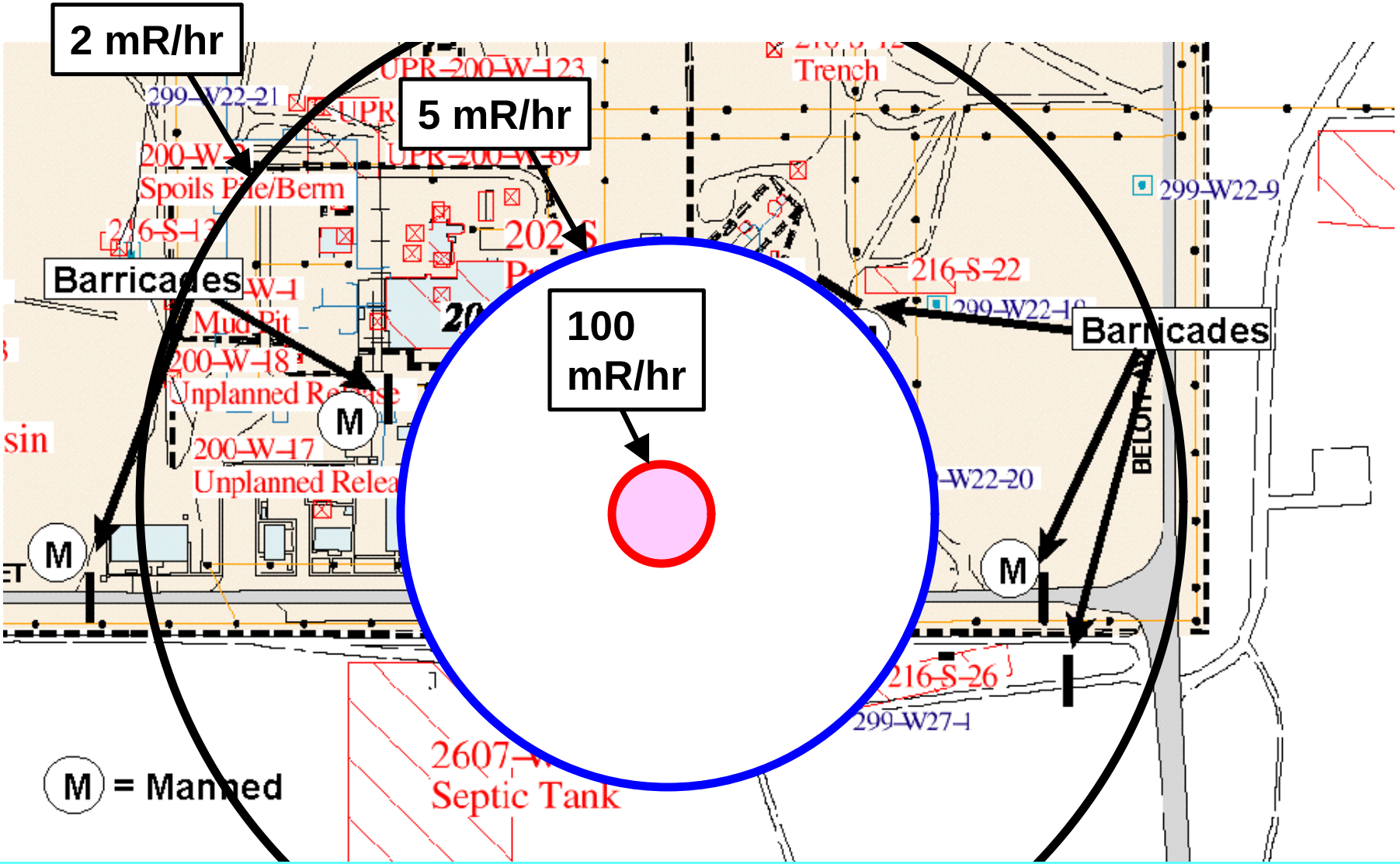
Contingency Planning

- Included In Written Procedure
  - Source Outside Containment
  - Blocked Tubing
  - Transfer Crank Breakage
  - Magnet Disconnect
  - Removable Contamination

Control Philosophy

- Full Personnel Accounting
- Lock and Tag
- Trained Personnel
  - Cold mockups
  - Team meetings
  - AJHA, JRC, Pre-jobs, etc.
- Road Closure
- Hot Operations On Weekends
- Limited Zone Access
- Approved Procedure
- Step-by-Step Signoff

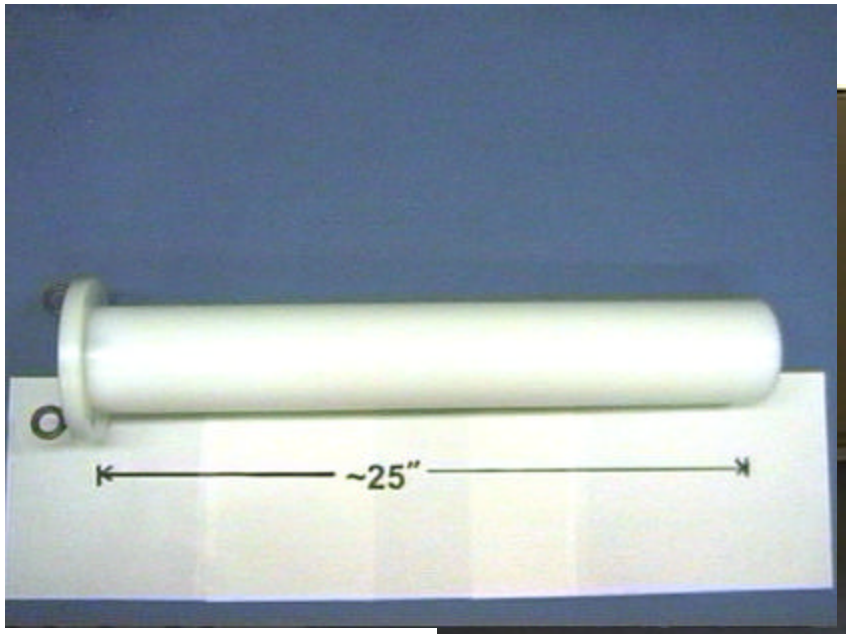
Transfer Control Zones



Cold Mockup

- Simulated Cask
- Progressive Transfer Tube Design
- Shield Plug Test
- Exercised Transfer Cable/Magnet
- Lessons Learned
  - Crank problems
  - Cable friction problems
  - Tubing and connection materials
  - Source drop-off technique failure

Cask Mockup



Cold Mockup

Cold Mockup

Drop-off Access Port

Drop-off Method

Cask Removal

Cask Placement

RADSTAR™ System

RADSTAR™ Readings

CAAF Source Transfer

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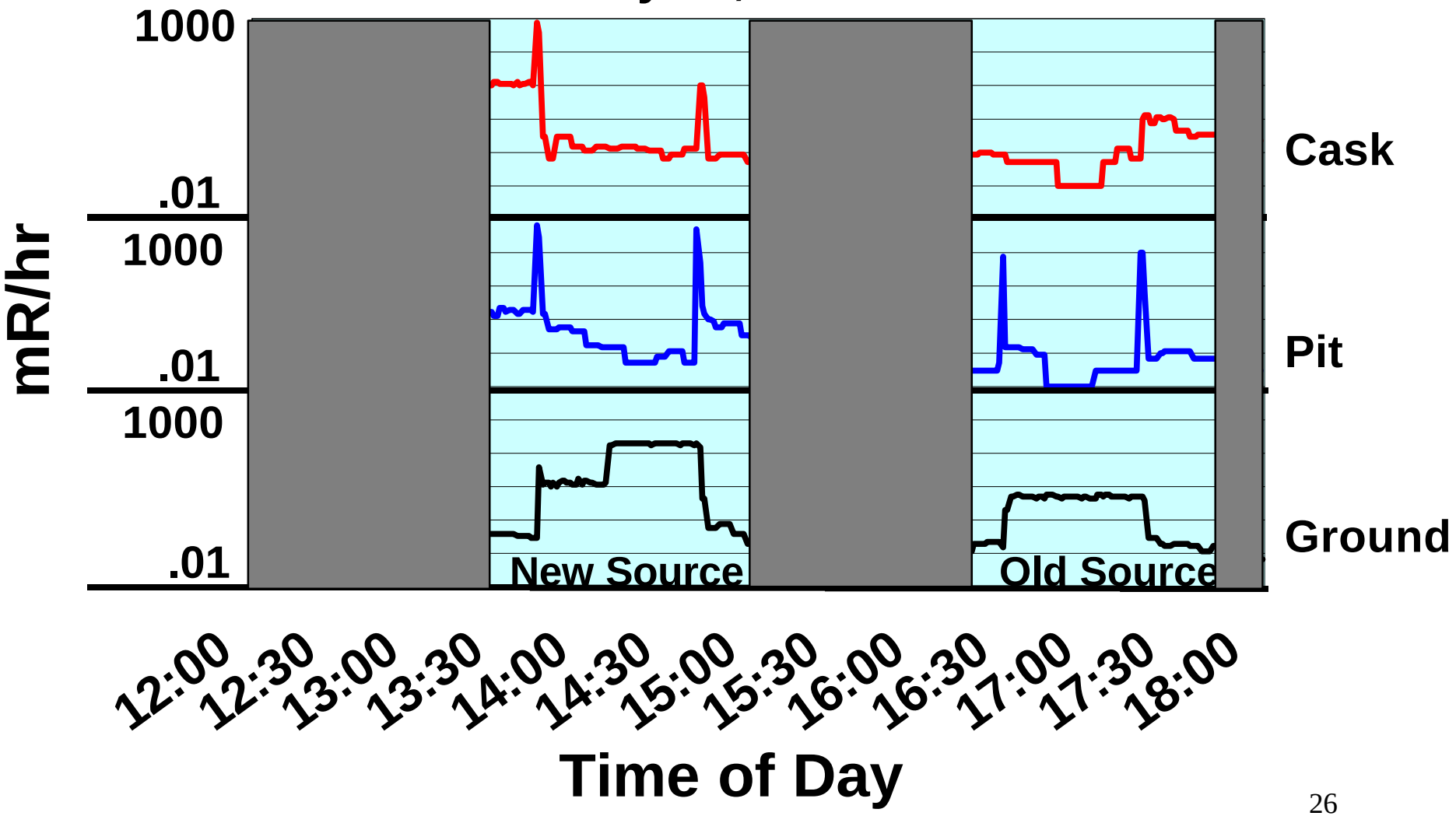

Event Observations

- Hot Mockup
  - Traffic control, mail delivery notification
  - Magnet contamination survey simplified
- Source 1
  - Snowball removal difficult, needed pre-stage
  - Road control improvement
  - Video surveillance
- Source 2
  - No problem
  - Reduced exposure with higher activity source

Job Collective Dose, mRem			
Event	ALARA Worksheet*	Rad Screen	Actual
Pre-Screen	450	-	-
Hot Mock Up	-	15	0
Source 1, 46mg ^{252}Cf	-	69.4	70
Source 2, 54mg ^{252}Cf	-	71.4	59

*1987 Time and Motion

Conclusions

- With Planning and Worker Involvement, Dose Can Be Reduced By:
  - Engaging resources early
  - Encouraging team innovations
  - Utilizing mock ups – cold and hot
  - Communicating status and progress
  - Planning for backup personnel
  - Breaking up work